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# मानक

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Mazdoor Kisan Shakti Sangathan

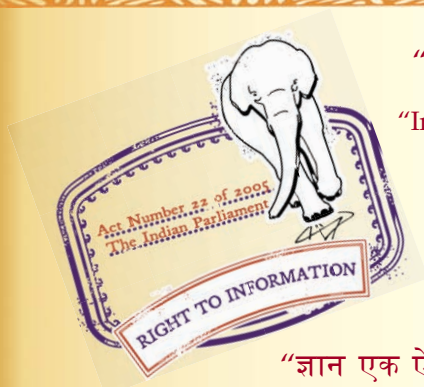
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IS 12044 (1987): Mechanically Operated Switches for use in Aircrafts [TED 14: Aircraft and Space Vehicles]



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“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*

SPECIFICATION FOR  
MECHANICALLY OPERATED SWITCHES FOR  
USE IN AIRCRAFTS

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# *Indian Standard*

## SPECIFICATION FOR MECHANICALLY OPERATED SWITCHES FOR USE IN AIRCRAFTS

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**IS : 12044 - 1987**

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## *Indian Standard*

# SPECIFICATION FOR MECHANICALLY OPERATED SWITCHES FOR USE IN AIRCRAFTS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 25 March 1987, after the draft finalized by the Aircraft Electrical Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** This standard covers the general requirements and tests for snap action mechanically operated plunger type limit switches for use in aircraft.

**0.3** In preparing this standard considerable assistance has been derived from 'BS 2G 213 : 1976 'Specification for mechanically operated switches', issued by British Standards Institution.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1260\*. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard specifies the general requirements and tests for snap action mechanically operated plunger type limit switches for use in nominal 28 V dc and single-phase supplies of 115/200 V, 400 Hz ac systems in aircraft.

### 2. TERMINOLOGY

**2.0** For the purpose of this standard, the following definitions shall apply.

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\*Rules for rounding off numerical values (*revised*).

**2.1 Actuating Force** — The force required to move the actuating plunger from the free position to the operating position.

**2.2 Release Force** — The value to which the actuating force shall be reduced in order to permit the plunger to move back to the release position after operation.

**2.3 Full Overtravel Force** — The force necessary to move the actuating plunger from the free position to the total travelled position.

**2.4 Pre-travel** — The distance between the free position and the operating position ( *see* Fig. 1 ).

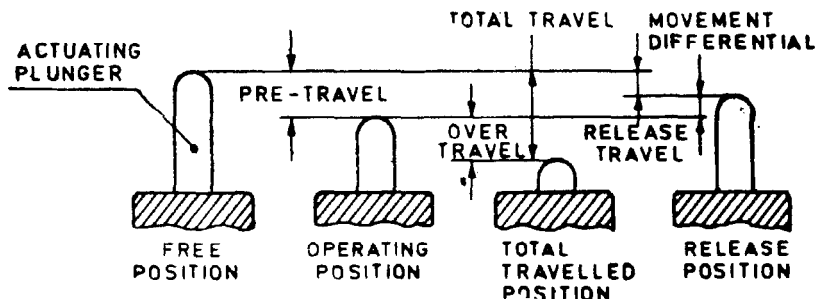


FIG. 1 SWITCH POSITIONS

**2.5 Overtravel** — The distance between the operating position and the total travelled position.

**2.6 Movement Differential** — The distance between the operating position and the release position.

## 2.7 Free Position

**2.7.1 Switches with Two or More Mounting Roles at Right Angles to the Plunger Centre Line** — The position of the face of the actuating plunger when no external mechanical force is applied to it, measured from a plane passing through the centre line of upper mounting holes.

**2.7.2 Switches with Single-Hole Mounting with a Threaded Turret in Line with the Plunger, Centre Line** — The position of the actuating plunger, when no external mechanical force is applied to it, measured from a chosen datum plane passing through the threaded turret.



**2.8 Operating Position** — The position of the face of the actuating plunger, measured as in 2.7.1 or 2.7.2 as appropriate at the instant when an increasing applied force has just caused the switch contacts to change over.

**2.9 Release Position** — The position of the face of the actuating plunger, measured as in 2.7.1 or 2.7.2 as appropriate, at the instant when decreasing applied force allows the switch contacts to revert to their initial state.

**2.10 Total Travelled Position** — The position of the face of the actuating plunger, measured as in 2.7.1 or 2.7.2 as appropriate, when an increasing applied force has caused it to move to the actual limit of permissible travel.

**2.11 Operation** — A cycle of movement of the plunger such that all the contacts function and then return to their original position.

**2.12 Normal Temperature, Pressure and Humidity**

Temperature : 15 to 35°C

Pressure : 86 to 106 kPa

Humidity : 45 to 75 percent

**2.13 Repeat or Repeatability** — The tolerance achieved on the operating or tripping point throughout the operational life of any one switch.

**2.14 Simultaneity** — The degree of coincidence of the operating or release positions of either:

- a) all sets of contacts of a multi-pole switch expressed in distance travelled by the actuator; or
- b) two or more separate sensitive switches mounted in a common switch assembly ( or enclosure ) expressed in distance travelled by the actuator.

**2.15 Deadbreak** — The condition at the operating or release position where any contact is open circuit and the snap action has not been completed.

**2.16 Deadbreak Travel** — The actuation travel distance over which the deadbreak condition exists.

**2.17 Snap Action** — A rapid **motion** of the contacts from one position to another, or their return. **This** action is relatively independent of the rate of travel of the actuator.

**2.18 Quality Assurance** — The description of those tests performed to verify that the standard proven by type testing has been maintained over an extended period until requalification is required.

**2.19 Sample** — An individual switch, for test, selected according to an agreed plan, and which is identified throughout testing by an arbitrary number allocated as required by this standard.

**2.20 Type Tests** — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general qualities and design of a given type of switch.

**2.21 Acceptance Tests** — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

**2.22 Routine Tests** — Tests carried out on each switch to check the essential requirements which are likely to vary during production.

### **3. DESIGN AND CONSTRUCTION**

**3.0** All switches shall comply with the requirement of this standard and where relevant those of IS : 10240-1982\*.

**3.1** The method of actuation shall be by means of a plunger which on depression or release, within the range of speed of operation, shall impart a snap action to the switch contacts.

**3.2** The complete switch should preferably be hermetically sealed, but it is anticipated that certain other designs will meet the requirements of this standard ( for example, plungers incorporating scraper rings and compression type seals with outgoing terminations from the switching compartment hermetically sealed ).

**3.3** Overtravel of the actuating plunger shall be provided after the switch snap action has taken place.

**3.4** The switches are intended to be operated by a force axial to the plunger centre line, but the design should be suitable for operation by oblique force up to 15° from the plunger centre line.

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\*General requirements for aircraft electrical equipment for aircrafts.

**3.5** Full overtravel may be utilized at all times without affecting the electrical or mechanical life of the switch.

**3.6** The actuating plunger shall be insulated from all current carrying parts. All other exposed metal parts shall also be insulated from current carrying parts.

**3.7** Termination shall be by any of the following methods:

- a) Terminal blocks with screwed terminations having threads complying with the requirement of relevant Indian standard.
- b) 'Potted-in' flying leads which should preferably be 2 m in length. These leads shall be of extruded construction, yellow in colour and etched to improve sealing. Other approved cables of comparable flexibility may be used.
- c) Terminal junctions of an approved standard suitable for size 20 cable.
- d) Connectors of an approved standard.

**3.8** Each termination or cable shall be identified by a number in accordance with the diagram on the switch and appropriate switch drawings.

**3.9** The switches shall be suitable for mounting in any attitude.

**3.10** The switches shall be suitable for use at the altitude ( or equivalent pressures ) and the temperatures for correct operation and non-derangement as given in **7.0.1** and **7.0.2**.

## **4. RATING**

**4.1** Switches shall be designed to operate on 28 V dc or 115 V ac, 400 Hz and shall be suitable for the 'nature of loads' required in Table 1 col 8 at the declared current ratings.

## **5. DECLARATIONS**

**5.1** In addition to the declarations required by IS : 7854-1975\*, the manufacturer shall declare the following:

- a) The limits of the following forces applied axially ( and obliquely, if applicable ) to actuate the switch plunger:
  - 1) Actuating force,

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\*Specification for voltages and frequency for aircraft electrical systems.

- 2) Full overtravel force,
  - 3) Release force, and
  - 4) Plunger overload.
- b) The limits of the plunger travel required to bring about the following:
- 1) Pre-travel,
  - 2) Overtravel,
  - 3) Movement differential travel,
  - 4) Operating position,
  - 5) Release position,
  - 6) Total travelled position,
  - 7) Free position,
  - 8) Deadbreak; and
  - 9) Simultaneity.
- c) The system of batching used for quality test sampling.

## **6. MARKING**

**6.1** In addition to the switching sequence diagram and outgoing terminal or flying lead numbering, the following information shall be clearly and indelibly marked on each switch:

- a) The manufacturer's type number;
- b) The manufacturer's name or identification;
- c) The number of this Indian Standard;
- d) The manufacturer's serial number;
- e) Resistive current rating; and
- f) Voltage ( dc and ac ).

**6.1.1** The switch may also be marked with the Standard Mark.

**NOTE** — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

**TABLE 1 ELECTRICAL AND MECHANICAL LOADING CONDITION**

(Clauses 4.1, 7.18, 7.18.1 and 7.18.4)

NUMBER OF OPERATION  Total per Switch	CONDITIONS OF ENDURANCE TEST		TESTS FOR EFA	ELECTRICAL LOADING				MILLIVOLT DROPS INITIAL	MILLIVOLT DROPS DURING AND AFTER TESTS
	Temperature °C ± 5°C	Altitude		Volts	Amperes	Operations/ Minute	Nature of Load		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50 percent	Maximum declared temperature	Sea level							
50 percent	— 54	21 300 m		28 V dc	As declared on DDP	25	Resistive	See 7.11	See 7.11.1
50 percent	Maximum declared temperature	Sea level			As declared on DDP				
50 percent	— 54	21 300 m	*	28 V dc		25	Inductive	See 7.11	See 7.11.1
100 percent	20	Sea level		28 V dc	As declared on DDP	25	Lamp load	See 7.11	See 7.11.1
50 percent	20		*	28 V dc	As declared on DDP	25	Low level resistance	See 7.11	See 7.11.1
50 percent	— 54	Sea level							
100 000	20 (i)	Sea level	—	—	—	50	—	—	—
total sub- divided as follows:	Maximum class tempera- ture (ii)					( axial mechanical endurance only )			
80 000 (i)	Minimum class tempera- ture (iii)								
10 000 (ii)									
10 000 (iii)									

(Continued)

TABLE 1 ELECTRICAL AND MECHANICAL LOADING CONDITION — Contd

NUMBER OF OPERATION  Total per Switch	CONDITIONS OF ENDURANCE TEST		TESTS FOR EFA	ELECTRICAL LOADING				MILLIVOLT DROPS INITIAL	MILLIVOLT DROPS DURING AND AFTER TESTS
	Temperature °C $\pm$ 5°C	Altitude		Volts	Amperes	Operations/ Minute	Nature of Load		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
100 000 total sub- divided as follows: 80 000 (i) 10 000 (ii) 10 000 (iii)	20 (i) Maximum class tempera- ture (ii) Minimum class tempera- ture (iii)	Sea level	*	—	—	50 ( oblique mechanical endurance only )	—	—	—
100 percent	20	Sea level		115/200 V ac	As declared on DDP, if applicable	25	Resistive	See 7.11	See 7.11.1
50 percent	20	21 300		115/200 V ac	As declared on DDP, if applicable	25	Inductive	See 7.11	See 7.11.1
50 percent	20	Sea level							

NOTE 1 — The Total number of operations to be completed with electrical loading should be selected from the following value: 50 000 or 100 000. Whichever value is selected is to be declared.

NOTE 2 — Column 4 shows the particular tests required for experimental flight approval.

NOTE 3 — Two switches should be tested each loading condition quoted, one carrying the load through the normally open contacts and the other through the normally closed contacts.

NOTE 4 — Values of current in column 6 should be the maximum full load currents declared with the exception of that for the low level resistive load which shall not exceed 75 mA.

## 7. TESTS

### 7.0 General

**7.0.1** The switches shall be suitable for use at different conditions of severities of temperature, however; the upper limit of ambient temperature shall be 90°C. Switches shall be capable of carrying their maximum rated current through all contacts for two-hours at the appropriate maximum ambient temperature.

**7.0.2** The switches shall be suitable for continuous operation at pressures equivalent to any altitude between sea level and 21 300 m.

**NOTE** — Unless otherwise specified, tests shall be carried out at normal temperature and pressure.

**7.0.3** All tests shall be carried out with the switch mounted on a metal plate earthed through a 100 mA fuse.

**7.0.4** The switch action during all plunger travel tests shall be controlled using a micrometer screw thread device.

**7.0.5** During any checks to ensure correct operation indicating lamps 2.5 W or 3.5 W at 28.5 V shall be connected to the terminals of each circuit of the switch.

**7.0.6** For dc inductive endurance load tests, 100 mH air cored coil shall be used.

**7.0.7** After all manufacturing processes and finishes have been completed and inspected, each switch shall be operated 200 times to minimum overtravel with no electrical load.

**7.1 Type Tests** — The following shall constitute the type tests:

- a) Workmanship and finish ( *see* 7.4 );
- b) Marking ( *see* 7.5 );
- c) Correct contact sequence ( *see* 7.6 );
- d) Mechanical calibration ( *see* 7.7 );
- e) Sealing ( *see* 7.8 );
- f) High voltage ( *see* 7.9 );
- g) Insulation resistance ( *see* 7.10 );
- h) Voltage drop ( *see* 7.11 );
- j) Mass ( *see* 7.12 );

- k) Strength of actuator, terminals and mountings ( *see* **7.13** );
- m) Continuous current and non-derangement ( *see* **7.14** );
- n) Icing ( *see* **7.15** );
- p) Short circuit ( *see* **7.16** );
- q) Overload ( *see* **7.17** );
- r) Endurance test ( *see* **7.18** );
- s) Vibration ( *see* **7.19** );
- t) Acceleration ( *see* **7.20** );
- u) Climatic ( *see* **7.21** );
- v) Fluid contamination ( *see* **7.22** );
- w) Sand test ( *see* **7.23** );
- x) Salt mist test ( *see* **7.24** );
- y) Explosion proofness ( *see* **7.25** ); and
- z) Magnetic influence ( *see* **7.26** );

**7.1.1** Type tests shall be made on switches which have previously passed the routine tests. Each basic type of switch shall be subjected to type tests in accordance with the schedule approved by the type approving authority. If a sample fails in any one of the tests, two further samples shall be subjected to the same series of tests up to completion of the test in which the first sample failed and then one of the two shall continue the schedule to completion. If either of the second sample quantity also fails, then that batch of switches shall be deemed to have failed to meet the requirements of this standard.

**7.2 Acceptance** — The following shall constitute the acceptance tests:

- a) Mechanical calibration ( *see* **7.7** );
- b) High voltage ( *see* **7.9** );
- c) Insulation resistance ( *see* **7.10** );
- d) Voltage drop ( *see* **7.11** );
- e) Mass ( *see* **7.12** );
- f) Strength of actuator terminals and mounting ( *see* **7.13** );
- g) Continuous current and non-derangement ( *see* **7.14** );
- h) Icing ( *see* **7.15** );



- j) Short circuit ( *see* 7.16 );
- k) Overload ( *see* 7.17 );
- m) Endurance test ( *see* 7.18 );
- n) Vibration ( *see* 7.19 ); and
- p) Acceleration ( *see* 7.20 ).

**7.2.1** The number of samples for acceptance tests shall be as agreed to between the purchaser and the manufacturer.

**7.3 Routine Tests** — The shall constitute the routine tests:

- a) Workmanship and finish ( *see* 7.4 );
- b) Marking ( *see* 7.5 );
- c) Correct contact sequence ( *see* 7.6 );
- d) Mechanical calibration ( *see* 7.7 );
- e) Sealing ( *see* 7.8 );
- f) High voltage ( *see* 7.9 );
- g) Insulation resistance ( *see* 7.10 ); and
- h) Voltage drop ( *see* 7.11 ).

**7.3.1** Routine tests shall be carried out on each switch in the order stated.

**7.4 Workmanship and Finish** — Each switch shall be inspected for conformity to the relevant drawings. Workmanship; finish and general assembly shall be satisfactory.

**7.5 Marking** — Each switch shall satisfy the requirements of 6.

**7.6 Correct Contact Sequence** — Using indicating lamps, each switch shall be checked to ensure that the appropriate contacts and circuits are made when the switch is operated during all the plunger travel checks in 7.7. Movement of the plunger in both directions shall impart a snap action to the switch contacts on opening and closing.

**7.7 Mechanical Calibration**

**7.7.1 Actuating Forces** — The forces (a) to (c) required to actuate the switch plungers to the operating, release and total travelled positions

shall be measured axially with the plunger and shall comply with the declared limits. The requirements of **7.0.4** and **7.0.5** shall apply.

- a) Actuating force,
- b) Release force, and
- c) Full overtravel force.

When switches are designed to be operated by forces applied obliquely or in directions other than axially (*see 3.4*), forces (a), (b) and (c) shall also be measured for this type of operation.

**7.7.2 Travel Characteristics** — The travels required to actuate the switch plunger with uni-directional movement to the positions specified in (a) to (j) shall be measured axially with the plunger and shall comply with the declared limits. The requirements of **7.0.4** and **7.0.5** shall apply.

- a) Pre-travel,
- b) Overtravel,
- c) Movement of differential travel,
- d) Free position,
- e) Operating position,
- f) Release position,
- g) Total travelled position,
- h) Deadbreak, and
- j) Simultaneity.

**7.8 Sealing** — Switches shall be subjected to the requirements of **7.8.1** and either **7.8.2** or **7.8.3** according to the declared category of sealing, followed by **7.8.4**.

**7.8.1 Leakage Test** — The switch shall be immersed in a suitable wetting agent, and then transferred to a bath containing a mixture of distilled water and the wetting agent in such proportions that the surface tension is reduced to 0.3 N/m at standard atmospheric temperature. The air pressure above the surface of the bath shall be reduced to 7.2 kPa. No evidence of leakage at the switch shall be observable during a period of five minutes.

All switches shall be subjected to and pass the leakage test specified. Switches shall be given five operations during the period of this test in order to demonstrate sealing under dynamic conditions.

**7.8.2 Hermetic Sealing** — The switches shall be subjected to a suitable test ( for example, mass spectrometer ) to determine the leakage rate, which shall not exceed the equivalent of  $3 \text{ cm}^3$  per year at a differential pressure of one atmosphere. All hermetically sealed cavities shall be subjected to individual tests.

**7.8.3 Environmental Sealing** — The switches shall be immersed for 1 h in a vessel containing water and a suitable wetting agent and subjected to an external pressure of 17.2 kPa. The switch shall pass the test without any leakage.

**7.8.4 Standard of Acceptance** — Immediately following these tests, excessive moisture shall be removed from the switches which shall then meet the requirements of 7.7, 7.10 and 7.11.1. After a 24 h recovery period at normal temperature, tests specified in 7.9 and 7.10 shall be performed. Following these tests, the switches shall be opened and examined in order to ascertain that no water ingress has occurred.

**NOTE** — As a routine test, environmental free switches shall be subjected to and pass the test in 7.8.1 except that the five operations need not be done after removal from the water bath the switches shall be dried. Hermetically sealed switches shall be subjected to tests in 7.8.2 in the subassembly stage and to 7.8.1 in the final stage.

**7.9 High Voltage** — Switch shall be subjected to the voltage test specified in the relevant Indian Standard with the plunger in the depressed and released position. The switch shall withstand the high voltage without any arcing or puncture.

**7.10 Insulation Resistance** — Switches shall be subjected to the insulation resistance test specified in 3.11 of IS : 10240-1982\*.

**7.11 Voltage Drop** — The voltage drop measured across any pair of terminals or 'potted-in' leads measured for five consecutive operations of the switch shall not exceed a value commensurate with 40 Megohms resistance, excluding lead wire resistance.

**7.11.1** During and at the conclusion of certain tests voltage drop measurements are specified. These shall be conducted as specified in 7.11 but the value shall not exceed a value commensurate with 50 Megohms, excluding lead wire resistance.

**7.11.2** The measurements shall be taken using the test currents in use during endurance tests, and at all other times using the nominal rated resistive load.

**7.12 Mass** — The switches, including all mounting hardware, shall be weighed. The weight shall not exceed the declared value.

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\*General requirements for electrical equipment for aircraft.

### 7.13 Mechanical Strength of Actuator, Terminations and Mounting

**7.13.1** The terminals, when the switch is mounted normally, shall withstand the tightening torques and pull forces for 1 min as given below. The pull shall be applied both along the axis and at right angles to the axis of the terminal screw or along the lead wire slot, if appropriate. No damage shall be incurred.

<i>Size of Thread</i>	<i>Tightening Torque</i>	<i>Pull Force</i>
	N-m	N
M 3	1.0	45
M 4	2.0	45
4-40 UNC	0.65	45
6-32 UNC	1.2	45

**7.13.2** Switches having 'potted-in' flying leads, when mounted normally; shall have each lead, in turn, subjected to a pull of 45 N in a direction along the line of the lead. No damage shall be incurred.

Switches having terminal junctions shall have each lead, in turn, subjected to pull of 90 N. The axial movement of the cable at the pin shall not exceed 0.3 mm and no electrical discontinuity shall occur during the test. No damage shall be incurred.

**7.13.3** When mounted normally, the switch shall be subjected to the plunger overload force specified in 5 applied to the switch plunger in the direction of travel for 1 min. No damage shall be incurred.

**7.13.4** Bushing mounted switches shall be mounted on a metal panel using normal mounting means with the hardware specified. A torque 3.5 Nm shall be applied to the mounting nut. If the unit has provision for a non-turn device, the mounted switch housing shall additionally be subjected to a torque of 0.5 Nm with the non-turn device mounted on the switch in the normal manner. No damage shall be incurred.

**7.13.5** Mounting screws on multi-hole mounting switches shall be subjected to a torque of 0.65 Nm.

**7.13.6** On completion of these tests the switch shall continue to function normally and shall be checked for compliance with the requirements of 7.7, 7.8.1, 7.10 and 7.11.1.

**7.14 Continuous Current and Non-Derangement** — For the purposes of these tests, except for flying-lead types, at least 2 m of size

20 cable shall be attached to each termination and not more than 1 m of this length shall be housed inside the heating chamber.

**7.14.1** All normally open and normally closed contacts, in turn, shall carry for a period of not less than 2 h the full electrical load at the maximum ambient temperature. After this time the terminal temperature rise shall be measured and shall not, when added to the ambient temperature, exceed the limitations of the materials used in the switch. In the case of switches with flying leads the measurements shall be made on the conductor 25 mm from the point of exit from the switch.

**7.14.2** Where a non-derangement temperature is declared, the switch shall be maintained at this temperature for the specified period and no damage or derangement shall occur.

**7.14.3** On completion of this test and whilst at maximum temperature the insulation resistance shall be measured as in **7.10**. The insulation resistance shall not be less than 10 M  $\Omega$ .

**7.14.4** After a recovery period of up to 24 h at normal ambient temperature, the switch shall comply with the requirements of the tests in **7.7**, **7.10**, and **7.11.1**.

## **7.15 Icing**

**7.15.1** With the switch plunger in the free position, the switch shall be maintained at the minimum operating temperature for 1 h and shall then be placed in an atmosphere of 100 percent relative humidity at  $20 \pm 5^\circ\text{C}$  for 30 min. This cycle shall be repeated and the switches maintained at their minimum operating temperature for 2 h. The switches shall be checked at this temperature to ensure correct contact operation. The actuating force required for the first operation shall also be measured and shall comply with the value specified.

**7.15.2** The plunger shall be clamped with a suitable fixture at 1.5 to 1.8 mm overtravel past the point of contact changeover and subjected to the temperature cycling described in **7.15.1**. Switches shall not require a greater overtravel to break out from icing.

**7.15.3** During this test the switches shall be mounted in a vertical position with their plungers uppermost in order to obtain maximum ice formation around the plunger.

Any ice, which is formed, shall not adhere to the clamping arm of the fixture, nor interfere with the release of the switch.

**7.15.4** Whilst at the minimum temperature, the plunger restraint shall be removed suddenly, in a direction sensibly axial with the plunger centre line, so as not to impart any disturbing influence to the plunger. The interval between this action and the contact changeover, shall be measured electronically and shall not exceed 300 ms. (A suitable method of accomplishing this is shown in Fig. 3).

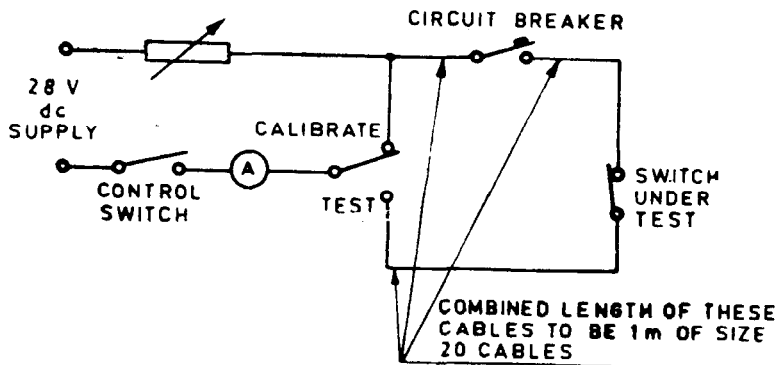


FIG. 2 TYPICAL TEST CIRCUIT FOR SHORT-CIRCUIT TEST

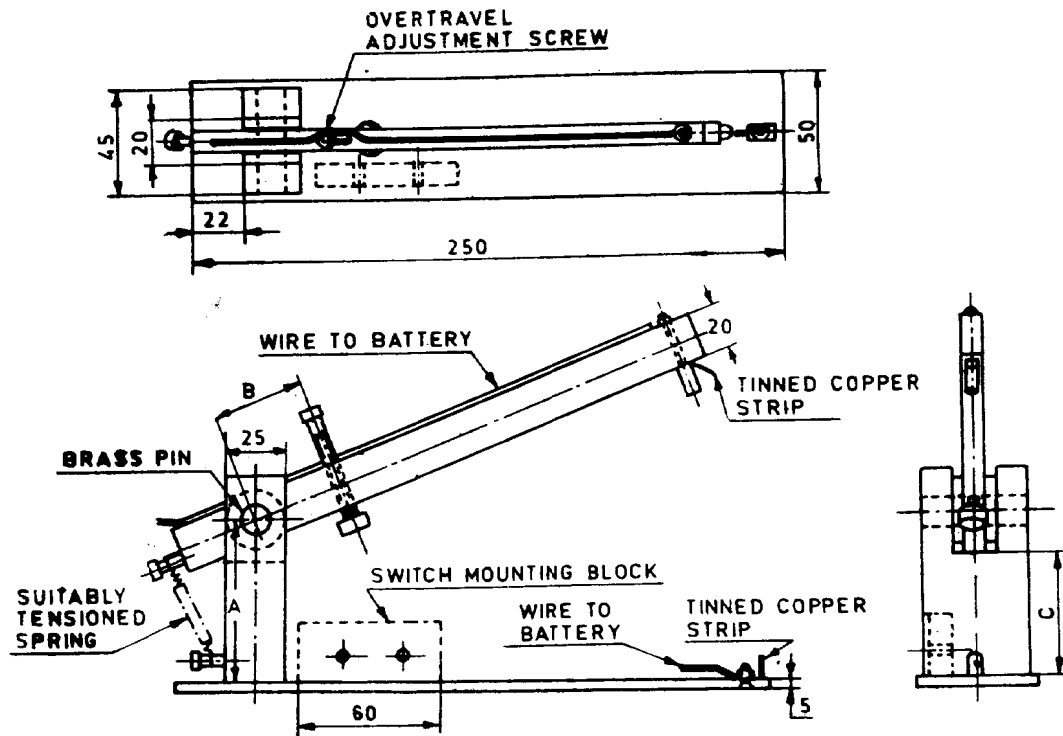
**7.16 Short Circuit** — The switches shall be subjected to the short-circuit tests whilst wired into a circuit as given in Fig. 2.

**7.16.1 Closed Circuit** — On the switch under test, one pair of normally closed contacts shall be wired into the circuit which shall be calibrated to supply a current of 60 times the resistive load. Calibration shall be made without the circuit-breaker, test switch and test leads in the circuit. With the switch under test in a closed position, the circuit shall be closed by a third switch. A minimum of 2 min shall elapse between successive operations of the third switch and the test shall be conducted five times. There shall be no welding or sticking of contacts, mechanical failure or damage to the switch after each short-circuit.

**7.16.1.1** The test shall be repeated on normally open contacts (with the switch plunger held in a depressed position).

**7.16.1.2** On completion of the above tests, checks shall be made to ensure compliance with the requirements of 7.7, 7.10 and 7.11.1.

**7.16.2 Making Circuit** — On the switch under test, one pair of normally open contacts shall be wired into the circuit which shall be calibrated to supply the same current (60 times the resistive load) as required in 7.16.1.



All dimensions in millimetres.

FIG. 3 SUITABLE SWITCH RELEASE TEST RIG FOR ICE TEST

#### Setting up procedure

- (a) Mount Switch on block.
- (b) With adjusting screw turned anti-clockwise to full extent solder 10A fusewire as a fusible link between tinned copper strips keeping it as short as possible.
- (c) Screw down adjusting screw with insulating pad on plunger until switch changes over.
- (d) Turn the screw to produce 1.5 mm over-travel.

NOTE 1 — Use silicon compound DTD 897A to grease pin and plunger dome.

NOTE 2 — Dimensions A, B and C to be made to suit switch types.

NOTE 3 — Switch mounting block to be dimensioned to suit switch types.

Calibration shall be made without the circuit-breaker, test switch and test leads in circuit. With the switch circuit under test in the open position, the supply shall be switched on and the contacts of the test switch shall then be closed on to the short-circuit and remain closed for not less than 20 s. After this test the switch contacts shall be opened and closed to prove there is no welding or sticking of the switch contacts, mechanical failure or damage.

**7.16.2.1** The test shall be repeated on a pair of normally closed contacts (with the plunger held in a depressed position and then released allowing the contacts to complete the short circuit).

**7.16.2.2** On completion of these tests, checks shall be made to ensure compliance with the requirements of **7.7**, **7.10** and **7.11.1**.

**7.17 Overload** — The switches shall be subjected to an overload test on a resistive load at 28.5 V dc on one pair of normally open contacts on one switch and one pair of normally closed contacts on another switch in turn. Fifty operations shall be completed on each switch at a speed of 5 to 6 operations per minute and the duty cycle shall be approximately 50 percent on and 50 percent off. The overload current for this test shall be 150 percent of the maximum resistive load current.

At the conclusion of the overload test, correct operation of these switches shall be checked in accordance with tests in **7.7**, **7.10** and **7.11.1**.

**7.18 Endurance Test Conditions** — The endurance test shall be carried out so that the number of operations, electrical loading and environmental conditions comply with the requirements of Table 1.

**7.18.1 Sinusoidal Operation** — Except as required in **7.18.2** and **7.18.3**, the rate of operation shall comply with the requirements of Table 1. The plunger displacement shall sensibly correspond to simple harmonic motion with 80 percent of the declared total plunger travel. On switches suitable for oblique plunger operation (*see 3.4*), endurance test shall be conducted on two samples to the maximum declared angle.

**7.18.2 Snap Release** — On one each type of switch, 50 percent of the total declared number of operations shall be conducted under fast release conditions. The plunger shall be depressed fully by means of a suitable rotating cam and cam-follower, differing from that in **7.18.1**, which will allow the plunger to release fully with an unrestricted snap action. The rate of operation shall be 5 to 10 operations per minute for the particular nominal resistive load.



**7.18.3 Fast Actuation** — On one other of each type of switch, 50 percent of the total declared number of operations shall be conducted under fast operation conditions for the particular nominal resistive load. The plunger shall be suitably depressed by an actuator moving at a sensibly constant velocity of at least 2 m/s over the distance moved by the plunger which shall correspond to not less than 80 percent of the total plunger travel of that particular type of switch.

**7.18.4 Endurance Test Checks** — During each of the foregoing endurance tests, voltage drop tests (*see 7.11.1*) and insulation test (*see 7.10*) shall be made at the intervals stated below and the results shall comply with the values required in Table 1.

<i>Number of Operations</i>	<i>Millivolt Drop and Insulation Resistance to be Measured at the Following Intervals</i>
Start	Start
100 000	Every 5 000 operations up to 20 000 operation and thereafter every 20 000 operations till completion of the test.
50 000	Every 2 500 operations up to 10 000 operations and thereafter every 10 000 operations till completion of the test.
25 000	At 2 500 operations, at 5 000 operations and thereafter every 5 000 operations till completion of the test.

**7.18.5** On completion of all above tests those tests specified in 7.7, 7.8.1, 7.9, 7.10 and 7.11.1 as shown in Table 1, shall be carried out and their requirements met.

**7.19 Vibration** — Vibration test shall be carried out as detailed in IS: 8252 (Part 14) - 1982\* 10-10 000 Hz each with plunger depressed to 1.5 to 1.8 mm beyond the operating point and with the plunger in free position. Fifty percent of each endurance run shall be carried out with the plunger in each of the two positions as detailed in IS: 8252 (Part 14) - 1982.\* Tests shall be made using an oscilloscope or a suitable indicating device at each frequency and amplitude to monitor that no inadvertent contact operation occurs.

**7.19.1** On completion of either of the tests above, test to the requirements of 7.7, 7.8.1, 7.9, 7.10 and 7.11.1 shall be met.

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\*Environmental tests for aircraft equipments: Part 14 Vibration.

**7.20 Acceleration** — Switches shall be subjected to acceleration tests under normal and crash conditions as specified in IS : 8252 ( Part 15 )\*.

**7.20.1** For the normal acceleration test, acceleration shall be applied alternatively in two applying directions in each of these mutually perpendicular planes as specified in **7.19**. Test lamps or other suitable indicating devices shall be connected to the open and closed contact terminations to determine the ability of the contacts to remain in the correct position.

**7.20.2** For the crash acceleration test switches shall comply with the conditions given in the relevant Indian Standard.

**7.20.3** At the conclusion of the acceleration tests, the switches shall satisfy the requirements of the tests in **7.7**, **7.10** and **7.11.1**.

**7.21 Climatic** — Switches shall be subjected to the climatic tests detailed in relevant Indian Standard.

During the tests the switches shall be mounted with their plungers uppermost, and shall have at least 2 m of size 20 cable attached to each terminal, approximately half of which shall be contained within the test chamber.

**7.21.1 Combined Humidity, Temperature and Pressure** — 28·5 V dc supply from a current limited source shall be connected across all normally open contacts. Means shall be provided for operating or releasing the switch plunger from the outside of the climatic chamber. One switch shall be tested with the plunger in the free position and a second switch with the plunger depressed 1·5 to 1·8 mm past the operating point. Switches shall not require a greater overtravel to break out from icing.

**7.21.1.1** During the above-mentioned tests, where functioning is required, the following requirements shall apply:

- a) The switches shall be actuated 50 times at the rates of 25 operations per minute whilst carrying full rated resistive load at 28·5 V dc. There shall be no malfunction and at the end of the sequence each switch shall comply with the requirements of **7.11.1**.
- b) Insulation resistance shall be measured as required in **7.10** and shall not be less than 10 M  $\Omega$ .

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\*Environmental tests for aircraft: Part 15 Constant acceleration ( under preparation ).

**7.21.1.2** At the conclusion of these tests the switches shall be removed from the cabinet and shall comply with the requirements of **7.7**, **7.10** and **7.11.1**. After a 24 h recovery period, at normal temperature, tests specified in **7.9** and **7.10** shall be performed.

**7.21.2 Tropical Exposure** — The switches shall be subjected to the test specified in relevant Indian Standard. Upon conclusion, the tests enumerated in **7.21.1.1** shall be repeated.

**7.21.3 Resistance to Mould Growth** — The switches shall be subjected to the 28 days test specified in the relevant Indian Standard upon conclusion then shall be inspected visually. There shall be no signs of mould growth and then shall comply with the requirements of **7.9** and **7.10**.

**7.22 Fluid Contamination** — Switches shall be subjected to the fluid contamination tests in accordance with the requirements specified in IS : 8252 ( Part 22 )\*.

At the conclusion of the test, and after reaching normal temperature, each switch shall be examined for any sign of deterioration, particular attention being given to the legibility and firmness of attachment of the identification labels.

The switches shall be subjected to and meet the requirements of **7.8**.

**7.23 Sand Test** — Switches shall be subjected to a sand test as described in IS : 8252 ( Part 7 )†.

At the conclusion of the test, the switches shall meet the test requirements of **7.7**, **7.10** and **7.11.1** and shall show no signs of mechanical damage.

**7.24 Salt Mist Test** — Switches shall be subjected to a salt mist test as described in IS : 8252 ( Part 10 )-1979‡. At the conclusion of the test the switches shall be subjected to and shall satisfy the requirements of **7.7**, **7.10** and **7.11.1**.

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\*Environments tests for aircraft equipment: Part 22 Fluid contamination ( under preparation ).

†Environmental tests for aircraft equipment: Part 7 Sand and dust ( under preparation ).

‡Environmental tests for aircraft equipment: Part 10 Salt mist.

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**7.25 Explosion Proofness** — Switches which comply with the requirement for sealing given in **7.8** shall be deemed to satisfy the explosion proofness requirements.

**7.26 Magnetic Influence** — Switches which embody magnets ( or any other device likely to cause magnetic influence ) shall be tested as described in IS : 8252 ( Part 18 )-1978 )\*.

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\*Environmental tests for aircraft equipment: Part 18 Magnetic influence.